

# INEL NEWS

The Idaho National Engineering Laboratory / October 7, 1986

## Prestigious I-R 100 award goes to engineers

A machine vision system developed by EG&G Idaho engineer Jon Bolstad, assisted by Michael Ward and Craig Shull, has been selected by Research & Development magazine as "one of the 100 most significant new technical products of the year." Winning products for the annual I-R 100 Awards are selected on the basis of their importance, uniqueness and usefulness from a technical standpoint as

determined by the magazine's editorial staff, advisory board and other selected experts.

The prestigious 1986 I-R 100 Award was presented to the three EG&G Idaho engineers for developing a Vision System for High Luminosity Processes, a system that produces high-quality video imagery of industrial or experimental processes which are normally obscured by the high luminosity of an electric arc, a plasma or a

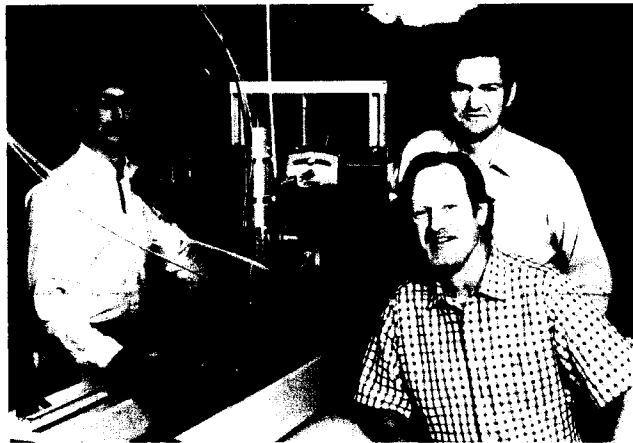
combustion flame.

The technology has particular application in electric arc welding where detailed vision of the welding pool, electrode, and liquid/solid interface is required. The welding site is illuminated by pulsed laser light transported to the welding torch by one or more optical fibers. The sensor assembly incorporates objective optics, a laser line filter, a microchannel plate image intensifier tube, and a CCD video camera. The intensifier tube is shuttered electronically in synchronism with the flash from the laser source, which occurs only once per video frame (or some multiple thereof). The shuttering interval (about 100 nanoseconds) is very small in comparison with the 33 millisecond integration time of a standard video camera. The welding arc light is almost totally eliminated from the video picture. Visibility through the arc is regained, and extreme variation in brightness across the picture is removed. The video imagery is much superior to standard video for interpretation by eye and by electronic image processing equipment.

This diagnostic and process control tool is receiving a very enthusiastic response from welding engineers and technologists.

Bolstad, principal engineer on the development team, came to the INEL in 1980 to establish closer contact with industrial and energy-related problems. He believes that electro-optical technology, including lasers, infrared equipment, fiber optics, machine vision, etc., will play a major role in the enhancement of U.S. industrial productivity, leading to an improved competitive strength for industry in the international economy.

Troy Wade, Manager of the Department of Energy Idaho Operations Office, accepted the I-R 100 Award on behalf of the Idaho National Engineering Laboratory at a banquet in the Great Hall of the Museum of Science & Industry in Chicago on Thursday, September 25.



WINNING THE PRESTIGIOUS I-R 100 award for their vision system for high luminosity processes was a tribute to the inventiveness of Craig Shull, Michael Ward and Jon Bolstad (seated) shown here with the system.

## Unique machine used in TMI-2 core boring

The second shipment of fuel from Three Mile Island Unit 2 (TMI-2) to the INEL contained samples from the recently completed TMI-2 core stratification sampling system (core bore) project. Troy Wade, DOE Idaho manager, commended Jim Zane, EG&G Idaho general manager, and the TMI-2 organization for successfully completing the core boring operations: "The success of this event could not have been accomplished without the dedication and determination of the EG&G staff. What was a vision three years ago to acquire and preserve representative samples of unknown regions of the core was turned into hardware and a successful operation..."

E. E. Kintner, Executive Vice President of GPU Nuclear Corporation, stated in a letter to Wade: "The design of the core boring equipment itself represented, as do so many tasks at TMI-2, a step into unprecedented areas. The fact that the equipment performed so well should be a basis for satisfaction within EG&G and your office."

An important and essential aspect of the TMI-2 defueling effort is to determine what occurred in the core region during the accident. Remote cameras and probes only portrayed a portion of the overall picture. What lay beneath the rubble bed and solidified sublayer was unknown.

Through the use of the TMI-2 Core Boring Machine, which was developed to drill into the damaged TMI-2 core, continuous samples of the previously molten materials could be extracted. This machine, its unique support structure, positioning and leveling systems, and specially designed drill bits provided a unique mechanical system with a computer which actually controlled the drilling operation. The computer prevents the operator from attempting actions outside of a predetermined specified operational envelope. Plant safety and operational interlocks are built into the system to prevent operations that could be dangerous to the operational crew or plant.

A data acquisition system, which is integrated with the controlling system, collects data relative to system conditions and monitors operational parameters during drilling. Data obtained while drilling were collected and stored in a data base. These data will assist in the actual mapping of the core region and identifying materials and stratification of structures that are present.

The system was designed and developed by EG&G and its subcontractors, who adapted a commercial drilling machine built for use in the geology and mining industries, to meet the special conditions within the TMI-2 reactor building and core. The complete system, which weighs about

20,000 pounds, had to be designed to fit through the containment air lock that is only about 3 feet by 6 1/2 feet. Design and construction took about 30 months. It took slightly over two years from proof of principle to the delivery of the system to Three Mile Island near Harrisburg. The actual installation of the machine, drilling the samples, placing the samples in canisters, and removing them took only 30 days.

After the drilling, the system was dismantled, removed from the work platform to retrieve the canisters containing the 14 core samples, and stored in the reactor building.

According to Mike Martin, EG&G project engineer, the most formidable challenge of the project was drill bit design. Core conditions dictated that the bit had to be capable of drilling both ceramic and metallic materials. This requirement is generally outside normal requirements and existing drill bit technology. The basic problem was that drill bits designed to cut metallic structures such as stainless steel or ceramic structures such as alumina had a very short drill life in the other material. Eleven drill bit designs were tested before a suitable bit was identified that would perform satisfactorily in

(continued on back page)